

CLAIMS

1. A pneumatic tire comprising at least one cord-reinforced layer made of metallic cords,
each said metallic cord made up of six to twelve metallic filaments whose diameter is in a range of from 0.15 to 0.45 mm,
said six to twelve metallic filaments including waved filaments and unwaved filaments,
each of the waved filaments being two-dimensionally waved at a wave pitch and wave height before twisted, wherein the wave pitch is in a range of from 5.0 to 35.0 times the diameter of the filament, and the wave height is in a range of from 0.2 to 4.0 times the diameter of the filament, and
the metallic filaments being twisted together into the cord at a twist pitch of from 10 to 40 mm so that the two-dimensionally waved filaments are each subjected to a certain rotation around its axial.
2. The pneumatic tire according to claim 1, wherein
said at least one cord-reinforced layer is a carcass extending between bead portions through a tread portion and sidewall portions,
said carcass comprising at least one ply of carcass cords extending between the bead portions,
each said carcass cord being made up of seven to twelve metallic filaments whose diameter is in a range of from 0.15 to 0.30 mm,
said seven to twelve metallic filaments being grouped into a plurality of elements, said plurality of elements being (i) bunches of two or three or four filaments, or (ii) one filament and bunches of two or three or four filaments,
said plurality of elements being twisted at a twist pitch P_c of from 10 to 25 mm,
each bunch including at least one waved filament and at least one unwaved filament,
the waved filament being two-dimensionally waved at a wave pitch and wave height before being twisted, wherein the wave pitch is in a range of from 5.0 to 30.0 times the diameter of the filament, and the wave height is in a range of from 0.5 to 4.0 times the diameter of the filament.
3. The pneumatic tire according to claim 2, wherein
the filaments in each said bunch are twisted at a twist pitch P_f of from 3 to 20 times the twist pitch P_c .
4. The pneumatic tire according to claim 2, wherein
each said bunch is made up of two or three filaments.
5. The pneumatic tire according to claim 2, wherein
the bunch includes plural kinds of waved filaments having different wave pitches.
6. The pneumatic tire according to claim 1, wherein
said at least one cord-reinforced layer is a belt disposed

radially outside a carcass in a tread portion,

said belt made of belt cords, each said belt cord made up of six to ten metallic filaments whose diameter is in a range of from 0.25 to 0.45 mm,

said six to ten metallic filaments being grouped into a plurality of elements, said plurality of elements being (i) bunches of two or three or four filaments, or (ii) one filament and bunches of two or three or four filaments,

said plurality of elements being are twisted at a twist pitch P_c of from 10 to 40 mm,

each bunch including at least one waved filament and at least one unwaved filament,

the waved filament being two-dimensionally waved at a wave pitch and wave height before twisted, wherein the wave pitch is in a range of from 5.0 to 30.0 times the diameter of the filament, and the wave height is in a range of from 0.2 to 3.0 times the diameter of the filament.

7. The pneumatic tire according to claim 6, wherein the filaments in each said bunch are twisted at a twist pitch P_f of from 3 to 20 times the twist pitch P_c .
8. The pneumatic tire according to claim 6, wherein each said bunch is made up of two or three filaments.
9. The pneumatic tire according to claim 6, wherein the bunch includes plural kinds of waved filaments having different wave pitches.
10. The pneumatic tire according to claim 6, wherein the diameter is in a range of from 0.25 to 0.35 mm.
11. The pneumatic tire according to claim 6, wherein the diameter is in a range of from 0.30 to 0.45 mm.
12. The pneumatic tire according to claim 1, wherein said at least one cord-reinforced layer is a bead reinforcing layer disposed in a bead portion,
said bead reinforcing layer being made of bead reinforcing cords,
each said bead reinforcing cord being made up of seven to twelve metallic filaments whose diameter is in a range of from 0.17 to 0.25 mm and a wrapping wire wound around the filaments and having a diameter in a range of from 0.13 to 0.17 mm,
said metallic filaments including at least two waved filaments and at least three unwaved filaments,
the waved filament two-dimensionally waved before twisted so as to be made up of straight segments in a zigzag formation,
all the waved filaments having the same wave pitch and the same wave height, the wave pitch being in a range of from 10.0 to 35.0 times the diameter of the filament, and the wave height being in a range of from 0.5 to 4.0 times the diameter of the filament, and the value dX_h/P_w is in a range of from 0.014 to 0.028,
said seven to twelve metallic filaments being twisted at a

twist pitch of from 10 to 30 mm while interchangeing at least two of said seven to twelve metallic filaments in their relative positions,

the wrapping wire being wound around the twisted filaments in a direction reverse to said twist direction at a winding pitch of 3.0 to 7.0 mm.

13. The pneumatic tire according to claim 12, wherein said seven to twelve metallic filaments are twisted such that

all the filaments as a bunch are rotated around the axis of the bunch in a direction so that each filament is essentially subjected to a rotation around the axis of the filament in the same direction as said direction.

14. The pneumatic tire according to claim 1, wherein said at least one cord-reinforced layer is

a carcass extending between bead portions through a tread portion and sidewall portions, and

a belt disposed radially outside the carcass in the tread portion,

said carcass comprising at least one ply of carcass cords extending between the bead portions, each said carcass cord being made up of seven to twelve metallic filaments whose diameter is in a range of from 0.15 to 0.30 mm, said seven to twelve metallic filaments being grouped into a plurality of elements, said plurality of elements being (i) bunches of two or three or four filaments, or (ii) one filament and bunches of two or three or four filaments, said plurality of elements being twisted at a twist pitch P_c of from 10 to 25 mm, each bunch including at least one waved filament and at least one unwaved filament, the waved filament being two-dimensionally waved at a wave pitch and wave height before being twisted, wherein the wave pitch is in a range of from 5.0 to 30.0 times the diameter of the filament, and the wave height is in a range of from 0.5 to 4.0 times the diameter of the filament, and

said belt made of belt cords, each said belt cord made up of six to ten metallic filaments whose diameter is in a range of from 0.25 to 0.45 mm, said six to ten metallic filaments being grouped into a plurality of elements, said plurality of elements being (i) bunches of two or three or four filaments, or (ii) one filament and bunches of two or three or four filaments, said plurality of elements being are twisted at a twist pitch P_c of from 10 to 40 mm, each bunch including at least one waved filament and at least one unwaved filament, the waved filament being two-dimensionally waved at a wave pitch and wave height before twisted, wherein the wave pitch is in a range of from 5.0 to 30.0 times the diameter of the filament, and the wave height is in a range of from 0.2 to 3.0 times the diameter of the filament.

15. The pneumatic tire according to claim 2, 6 or 14, wherein said at least one cord-reinforced layer further includes a bead reinforcing layer disposed in a bead portion, said bead reinforcing layer being made of bead reinforcing

cords,

each said bead reinforcing cord being made up of seven to twelve metallic filaments whose diameter is in a range of from 0.17 to 0.25 mm and a wrapping wire wound around the filaments and having a diameter in a range of from 0.13 to 0.17 mm,

said metallic filaments including at least two waved filaments and at least three unwaved filaments,

the waved filament two-dimensionally waved before twisted so as to be made up of straight segments in a zigzag formation,

all the waved filaments having the same wave pitch and the same wave height, the wave pitch being in a range of from 10.0 to 35.0 times the diameter of the filament, and the wave height being in a range of from 0.5 to 4.0 times the diameter of the filament, and the value dXh/Pw is in a range of from 0.014 to 0.028,

said seven to twelve metallic filaments being twisted at a twist pitch of from 10 to 30 mm while interchangeing at least two of said seven to twelve metallic filaments in their relative positions,

the wrapping wire being wound around the twisted filaments in a direction reverse to said twist direction at a winding pitch of 3.0 to 7.0 mm.